

# Parasphenopteris Sun & Deng, a new genus from the Lower Permian of Wuda, Nei Mongol, China

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**Abstract** *Parasphenopteris orientalis* Sun & Deng gen. & sp. nov. is described from the Shanxi (Shansi) Formation of the Lower Permian in the Wuda area of Nei Mongol, China. The new genus is characterized by having “stipules” at the base of penultimate pinnae and is quite different from all other known genera in the Paleozoic.

**Key words** *Parasphenopteris* Sun & Deng, *Parasphenopteris orientalis* Sun & Deng, new genus, new species, Lower Permian, Wuda, Nei Mongol, China.

The northern part of the Helan Mountain, where Wuda is located, is one of the most important localities of the Cathaysian flora. In this locality the Carboniferous and Permian are successional developed, which are rich in plant fossils. We have collected numerous well preserved plant fossils from the Wuda area of Nei Mongol during the long-term geological investigation in the area carried out since the 1990's. Some of the materials including new genera and species have been published recently (Sun & Deng, 1999, 2003; Sun et al., 1999; Deng et al., 2000). Our collection includes eight very interesting and excellently preserved specimens, which are described in the present paper. It is highly surprising that the fossil plant has “stipules” borne at the base of each of the penultimate pinnae. The presence of stipules characterizes some of the living angiosperms, such as *Pisum* L. of Leguminosae and *Smilax riparia* A. DC. of Smilacaceae, but has never been reported in the Palaeozoic plants described thus far. Such an unexpected character found in a Palaeozoic plant shows not only the importance of the fossils but also indicates that they represent a hitherto undescribed new plant. We consider that this plant is worthy of a generic rank. We therefore name the plant as *Parasphenopteris orientalis* Sun & Deng, gen. & sp. nov.

It is difficult to make a definite assignment of the new genus at the moment, but based on the morphology of the pinnate compound leaf, the new genus is most probably close to sphenopterides of the Filicopsida or the Pteridospermopsida.

## 1 Description

### *Parasphenopteris* Sun & Deng, gen. nov.

Generic diagnosis: The fronds are very large and at least tripinnate. Main rachis is smooth and thick. Penultimate pinnae are lanceolate. The rachises of penultimate pinnate are slender. Ultimate pinnae are narrowly deltoid-lanceolate to ovate-triangular, and closely set. The pinnules are sphenopteroid. This new genus has “stipules” at the base of each of the penultimate pinnae. The “stipules” are linear to linear-lanceolate. Pinnae are very small, ovate or ovoid-triangular.

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Type: *Parasphenopteris orientalis* Sun & Deng, sp. nov.

*Parasphenopteris orientalis* Sun & Deng, sp. nov. Fig. 1

The best specimen of this species is indicated in Fig. 1. The figure is in natural size. The frond is very large and is at least tripinnate. The main rachis is smooth and thick, 3 to 4 mm wide. Penultimate pinnae are lanceolate, alternate, 3 to 18 cm long, 0.6 to 3 cm wide, forming an angle of 80°–90° with the main rachis. The rachises of penultimate pinnate are slender, 1 to 1.5 mm wide. Ultimate pinnae are narrowly deltoid-lanceolate to ovate-triangular, closely set, forming angles of 40°–60° with the rachis. The “stipules” are borne at the base of each of the penultimate pinnae, linear to linear-lanceolate, 1.5 to 2.5 cm long, and often dissected into linear lobes. The pinnules are very small, ovate or ovoid-triangular. The pinnules are crowded and somewhat overlapping. The venation is indistinct.

Locality and horizon: The Shanxi Formation of the Lower Permian in the Wuda area of Nei Mongol, China.

Etymology: The generic name “*Parasphenopteris*” indicates that the fossils are similar to *Sphenopteris* morphologically, and the specific epithet “*orientalis*” refers to the locality of the materials.

Holotype: WD20026 (Fig. 1).

Repository: China University of Geosciences, Beijing, China.

## 2 Comparison and Discussion

A lot of living angiosperms have stipules. Stipules are commonly borne at the position where the petioles are attached, usually binate. The functions of stipules are considered as protecting the leaf buds and enlarging the photosynthesis area. Stipules are in various shapes. For examples, *Pisum* of Leguminosae has large stipules similar to the normal leaves, while *Sorbaria* (Ser. ex DC.) A. Braun of Rosaceae has small stipules; *Polygonatum* of Polygonaceae has membranous sheath-like stipules; and the stipules of *Smilax riparia* of Smilacaceae are tendril-like, which are very close to those of the new fossil plant here described.

Although the “stipules” of the new fossil plant are very similar to some of the living plants, we have added quotation marks to the term temporarily because a fossil plant with distinct stipules has yet never been reported so far from the Palaeozoic. It is noteworthy that the “stipules” are borne at both the basiscopic and acroscopic bases of each of the penultimate pinnae instead of at the bases of pinnules.

The present new genus and species are characterized by its multi-pinnate compound leaves, which are somewhat similar to those in the genus *Sphenopteris*. However, the presence of “stipules” in the species shows that it is obviously different from all the known Palaeozoic plants.

The discovery of *Parasphenopteris* has not only added a new member for the Cathaysian flora but also has provided a new clue of the evolution of plant organs in the plant kingdom. Possessing stipules is an advanced feature of plants. The current discovery indicates that the stipules have possibly appeared in the Late Palaeozoic, and that the new genus may be a linking group of the evolution of the plant kingdom.



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# 内蒙古乌达地区下二叠统植物化石新属—— 拟楔羊齿属

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**摘要** 描述了产于内蒙古乌达地区下二叠统山西组的东方拟楔羊齿 *Parasphenopteris orientalis* Sun & Deng (新属新种)。该植物以末二次羽片基部着生有“托叶”为特征, 区别于晚古生代其他已知植物。

**关键词** 拟楔羊齿; 东方拟楔羊齿; 新属; 新种; 下二叠统; 乌达; 内蒙古; 中国